

CLAIMS:

1. A cooling device for cooling a superconducting coil assembly in an MR apparatus, comprising:
 - a cooling chamber adapted to contain a cooling agent which is in thermal contact with the superconducting coil assembly,
 - 5 - a refrigerator for cooling the cooling agent, characterized in that it includes
 - a cooling agent storage in fluid connection with the cooling chamber, the cooling agent storage being adapted
 - to take up cooling agent from the cooling chamber when at least a part of the
 - 10 cooling agent in the cooling chamber exceeds a first predetermined temperature, and
 - to return cooling agent to the cooling chamber when at least a part of the cooling agent in the cooling chamber remains below or is equal to a second predetermined temperature.
- 15 2. A cooling device according to claim 1, wherein the cooling chamber is adapted to contain a cooling agent in a liquid and a gaseous condition and the fluid connection is connected to a part of the cooling chamber which is adapted to contain a gaseous cooling agent.
- 20 3. A cooling device according to claim 1, wherein the refrigerator has a cooling power sufficient to compensate heat transfer to the cooling chamber in regular condition so as to allow zero boil-off operation.
4. A cooling device according to claim 1, comprising means for controlling the
- 25 take up and return of the cooling agent by means of a signal derived from the pressure of the cooling agent in the cooling chamber.
5. A cooling device according to claim 1 or 2, wherein the refrigerator comprises a cooling surface in thermal contact with the cooling agent, the cooling surface extending

into the cooling chamber, in particular into that part of the cooling chamber which is adapted to contain a gaseous cooling agent.

6. A cooling device according to claim 1, wherein the cooling agent storage
5 includes a gasometer for storing the cooling agent at a constant predetermined pressure.

7. A cooling device according to claim 1, wherein the cooling agent storage
comprises:

- a pressure tank in fluid connection with the cooling chamber for taking up the
10 compressed cooling agent,
- a compressor means interposed in a fluid connection between the cooling
chamber and the pressure tank in order to compress the cooling agent exiting the cooling
chamber and
- a pressure reduction means interposed in a fluid connection between the
15 cooling chamber and the pressure tank in order to reduce the pressure of the cooling agent
returning to the cooling chamber.

8. A cooling device according to claim 1, wherein the cooling agent storage is
adapted to contain the cooling agent in a gaseous condition.
20

9. A cooling device according to claim 1, wherein the cooling chamber and the
cooling agent storage are adapted to contain helium as a cooling agent.

10. A cooling method for cooling a superconducting coil assembly in an MR
25 apparatus, wherein the superconducting coil assembly is cooled using a cooling agent which
is in thermal contact with the superconducting coil assembly in a cooling chamber, the
cooling agent being cooled by a refrigerator, characterized in that the method comprises the
steps of

- transferring cooling agent from the cooling chamber to a cooling agent storage
30 when a predetermined temperature is exceeded in at least a part of the cooling agent in the
cooling chamber, and
- returning cooling agent from the cooling agent storage to the cooling chamber
when the temperature of at least a part of the cooling agent in the cooling chamber is equal to
or less than the predetermined temperature.

11. A cooling method according to claim 10, wherein the cooling agent is in a gaseous and a liquid condition in the cooling chamber and the transfer and return of the cooling agent in the gaseous condition is controlled by means of a signal derived from the pressure of the cooling agent inside the cooling chamber, and
- 5 - the cooling agent is transferred from the cooling chamber to the cooling agent storage when a first predetermined pressure is exceeded in the cooling chamber, and
- the cooling agent is returned from the cooling agent storage to the cooling chamber when the pressure of the cooling agent in the cooling chamber is equal to or less
- 10 than a second predetermined pressure.
12. A cooling method according to claim 10, wherein the transferred cooling agent is
- compressed so as to be stored in a compressed state outside the cooling
- 15 chamber and
- decompressed so as to be returned to the cooling chamber.
13. An MR apparatus, comprising a superconducting magnet having a superconducting coil assembly and a cooling device according to claim 1 for cooling said
- 20 superconducting coil assembly.